VALUE OF LABORATORY CONTROL OF OPERATION OF WATER PURIFICATION PLANTS[1]

W. W. DeBerard: Samples taken from twelve different points over the system of the Denver Union Water Company last November and analyzed in four different laboratories indicated a remarkable uniformity of result, considering the fact that each laboratory used its own particular routine. This routine was essentially the same throughout except for the medium used in the fermentation tubes for the B. coli tests. One used lactose bile; another, fresh ox bile; another, "bacto-bile" and the fourth, dried ox gall. The laboratories collaborating were those of William C. Mitchell, city bacteriologist, Denver; Dr. John B. Ekeley, state chemist, University of Colorado, Boulder; H. I. DeBerard, chemist, Denver Union Water Company, and Prof. W. G. Sackett, bacteriologist, Colorado Experiment Station, Ft. Collins.

Some of the figures are as follows: From the infiltration galleries at Mississippi Street the average of five counts on gelatin at 20°C., after forty-eight hours was 11, with a maximum of 16 and minimum of 6. Raw samples taken from Marston Lake averaged 520, with a maximum and a minimum of 750 and 300 respectively. Similar figures for the effluent of the Platte Cañon slow sand filters, treated, were 49, 75 and 12. A mixed supply taken from the tap in the city chemical laboratory gave an average of 42, maximum of 69 and minimum of 21.

Typical results on agar at 37°C. for the Platte River, raw, are as follows: Average, 52; maximum, 73 and minimum, 17. For the Willard rapid filter effluent, treated, the average was 3, maximum 5, and minimum 2. From a drinking fountain at the corner of First Avenue and Broadway the average was 8, maximum 17 and minimum 3.

Equally close uniformity extended to the samples examined for B. coli per 100 cc. From the Mississippi Street galleries, Marston Lake treated, a slow sand filter effluent at Wynetka, Platte Cañon

[1] A discussion at a meeting of the Illinois Section at Urbana on March 13, 1917.

infiltration galleries, Willard rapid filters, a drinking fountain and the Cherry Creek infiltration galleries, no coli were found by the analysts.

O. M. SMITH: Laboratories in small plants are often placed in unoccupied corners somewhere in the filter or boiler room. Here they are neglected and gradually become an eyesore instead of an inspiration to the superintendent and the workman. The tendency of recent years has been to place more importance on the laboratory. Superintendents are finding that a well equipped and well appearing laboratory is quite an asset and a valuable advertising feature to the plant. The speaker understands that the American Water Works & Electric Company finds the attractive, clean and modern laboratory a paying investment and that it is its intention while rebuilding the plant at East St. Louis, Ill., to install one of the finest plant laboratories in Illinois. If the laboratory is kept clean, polished and has on exhibition interesting data and specimens, such as graphs of turbidity, number of typhoid cases, efficiencies, plates of bacteria, samples of water and sections of filters, visitors and the public will become vitally interested in what the company or department is endeavoring to do. An interested and sympathetic public is one of the company's best assets.

On the question of records, the speaker has found that if data such as pumpage, fuel duty, turbidity, coagulant, bacteria counts, efficiencies, cost, etc., are daily plotted on cross-section paper in such a manner as to be easily understood, the employes will become more interested in what they are doing and more in sympathy with the economical and efficient methods.

W. R. GELSTON: It is obvious that some systematic laboratory control should be applied to every water purification plant. The fact that a purification plant is necessary to make the water satisfactory is good evidence that the untreated supply is more or less turbid, colored, and polluted. The purification of a water supply adds very materially to the final cost to the department of delivering it to the consumer. We hear much in this enlightened age of "Safety First" and "Efficiency." "Safety First" applied to purification plant operation should mean that the primary object of the purification plant is to produce at all times an effluent safe for human consumption. "Efficiency" applied to plant operation means

economy. The man responsible for the operation of a water purification plant should adopt a motto something like this: "Strive for the best efficiency consistent with safety first."

Without laboratory control, the operator cannot be certain that he is reducing his coagulant and sterilizing cost to the minimum consistent with safety of effluent. Neither can he limit his laboratory control to a mere determination of the alkalinity, color, and turbidity of his raw water and effluent. He must apply bacterial control to determine whether the effluent is safe for human consumption or not.

At Quincy, alkalinity and turbidity determinations were begun many years ago. Bacterial control dates from 1909, when G. A. Van Brunt was sent to Quincy by the State Water Survey to install apparatus for bacterial tests and to instruct water works employees in the standard methods applied to such tests. A small laboratory was fitted up in one corner of the pumping station. Media were purchased from the State Water Survey. About five samples each of river, settled and filtered water were plated each week. This limited control soon demonstrated the need of extensive improvements. The improvements were not secured at once, but municipal history does not reveal many instances of locking the stable door before the horse is stolen.

A new purification plant was completed in August, 1914. A new intake pipe was completed a year later, and a liquid chlorine machine was installed early in 1916. Quincy now secures its water supply from a point in the Mississippi River which is not subject to pollution by sewage. The water is coagulated, settled, filtered and finally sterilized. That "Safety First" has been secured is evident from the mortuary records kept by the board of health. During 1916 there were two deaths from typhoid fever reported in Quincy. One was a case imported from Camp Point for treatment in a local hospital. The other was a young man who lived in a house not supplied with city water. Quincy has a population of about 38,000. Two deaths per year are, therefore, equivalent to 5.3 per 100,000. The lowest previous record for Quincy was seven deaths per year, or 19 per 100,000, and most of those deaths were probably due to an unsafe water supply.

Since safety is now secured it might be suggested that bacterial control is unnecessary or that the extent of such control might properly be curtailed. Nevertheless, it has been kept up regu-

larly. Just how it has been kept up may be of intere t. The speaker has always collected the samples, plated them, made the counts, and recorded the results. Since the new filter plant was erected he has also prepared all of the media used in the work. The filter man has been pressed into service to make the alkalinity, color and turbidity tests, and he also washes and sterilizes the glassware and assists in the preparation of the media. It requires about three and one-half hours of the speaker's time to prepare a 2-liter batch of agar which will last about five weeks, and about three hours to prepare sufficient lactose broth to last five weeks. It requires an average of about one and one-half hours to collect samples, plate them, make the counts, and record them. Samples are collected and plated about twenty times each month. Five different samples of water are collected for each plating and duplicate agar plates are run on each sample.

The filter man might be allowed to do all of this work, but the laboratory control supplies the only reliable check upon the filter man. The results of the bacterial tests, especially, show whether he has been faithful in the performance of his duty or not. Therefore, the speaker has always preferred to attend to the bacterial work himself.

It is now generally known throughout the city that the superintendent of the water department makes regular bacterial tests of the water and the consumers realize that everything possible is being done to insure a safe supply. He is sometimes called upon to test samples of water from private wells and cisterns. Such tests are always made without charge. Expert bacteriologists might possibly condemn this practice, but recently it was made to produce three water services where only one grew before. It happened in this way. A lady telephoned to inquire whether she could have a cistern water tested. She stated that she had been getting her water from a yard hydrant two doors away, but this hydrant was frozen up and she did not want to use the cistern water at her house until she knew that it was safe to drink it. The test was made and it was found that one man owned three cottages, all of them occupied by tenants. He laid a water service for one house and paid a flat rate for water for one house only. He then instructed the tenants in the other two houses to get water from the hydrant at the first house if they preferred the city water to cistern water. They preferred the city water and the landlord now pays for water for three houses where he paid for only one before.

L. A. FRITZE: The value of the laboratory in connection with the operation of water purification plants can best be judged by the results that are being obtained. The results firmly establish the fact that every filtration plant, even to the smallest, requires a laboratory to maintain an intelligent idea of the quality of the effluent produced. In the smaller plants, where the design and construction, as a rule, are less perfect, it is quite important that routine laboratory tests be made in order to obtain a satisfactory degree of purification. The tests required are simple and in these small plants a man with average intelligence can be trained to handle this work in a very satisfactory manner. In the plants, however, where it is possible to employ a chemist the operation will be placed upon a better basis and the proper solutions of the many little problems that arise will have a marked influence on conditions at the plant.

Aside from the daily routine analyses to determine the quality of the raw and filtered water and the work required to maintain the filters and other equipment in a satisfactory condition, there are other things in which the laboraory can prove its value. In the purchase of coal, chemicals and the large variety of material used by a water department the laboratory can be of the utmost importance. The handling of bad water complaints is another duty. Sediment or color, odor or taste will produce their share of objectors and if these consumers be referred to the laboratory for enlightenment, a non-technical explanation in a courteous manner will do a great deal towards making the chronic kicker and others good friends of the department.

In the municipally owned plants it is possible for the scope of the work of the laboratory to be enlarged to include a number of things. With the work of the water department properly systematized valuable assistance can be given to other departments of the city. The work of the health department requires the same care as that of the water department. Establishing and maintaining the standards of purity for the milk supply, ice cream and the various foods sold on the open market present problems only to be solved by the laboratory. Making examinations of sputum, diphtheria cultures, urine and other work, valuable to the physicians, will render the laboratory a valuable addition to the city. The street department can be aided by tests of the various materials used, and, in fact, everything purchased by the city, where an analysis is of use in determining value, the laboratory is a help.

A number of cities allow the matter of expense to stand in the way of having a municipal laboratory. When the work accomplished by a laboratory in a year's time is summed up, it is quite apparent that the financial saving exceeds the expense and the health work combined with the laboratory-control work for the filtration plant have cost the city very little. In this connection the speaker wishes to say that the valuable work carried on by the State Water Survey in checking the water supplies of the state and encouraging cities to establish municipal laboratories should be heartily endorsed.